

sPHENIX γ -Jet Projections

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5/15/17

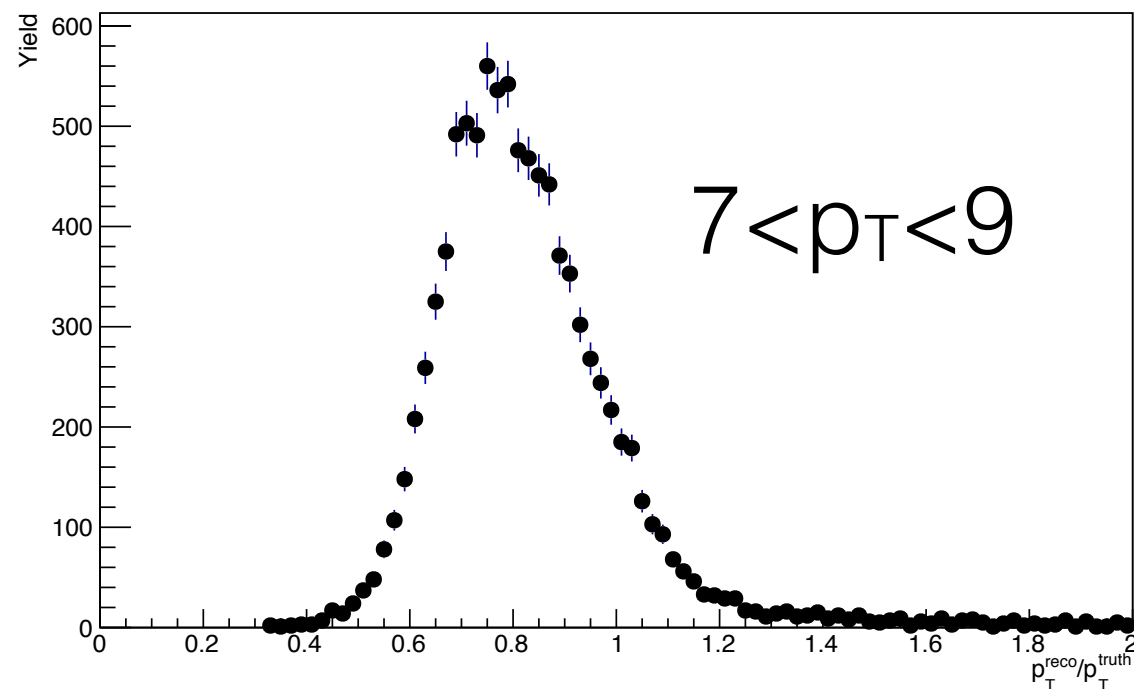
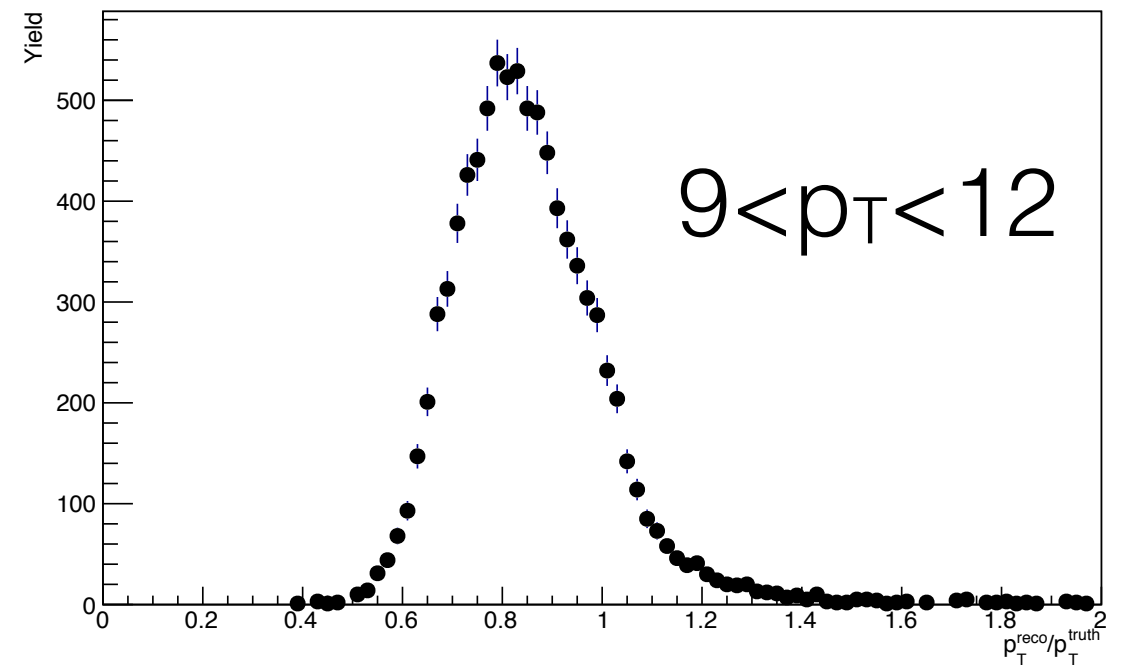
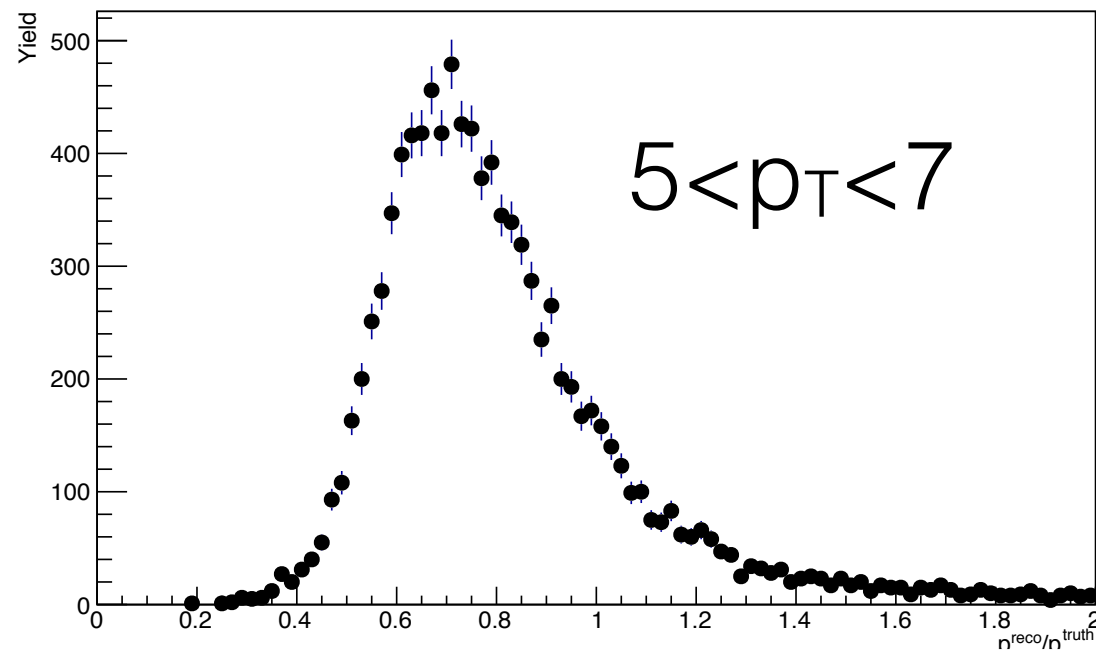
Motivation

- Reminder: Interested in γ -jet in p+p and p+Au collisions to study prediction of factorization breaking
- Following physics motivation in PRD 95, 072002
- Last presentation: January 11 before QM17
 - Was using QM17 high p_T γ -jet files from Dennis
- Today:
 - Full study of acceptance/efficiency and resolutions for statistical projections
 - Note: most of this has been presented in Cold QCD group and simulation meetings as well

Jet Response

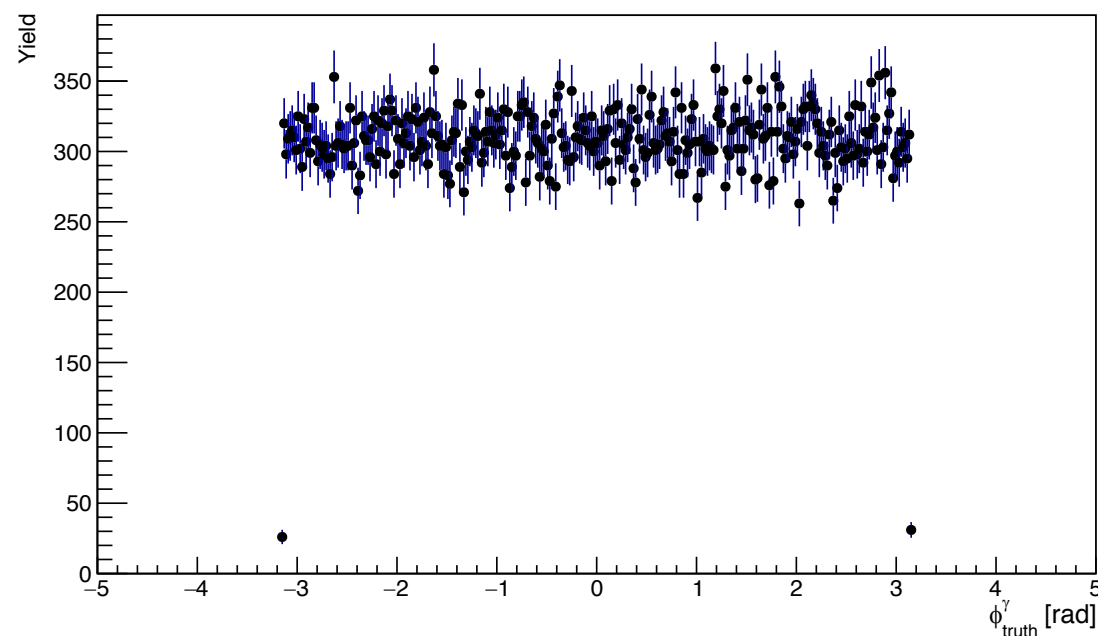
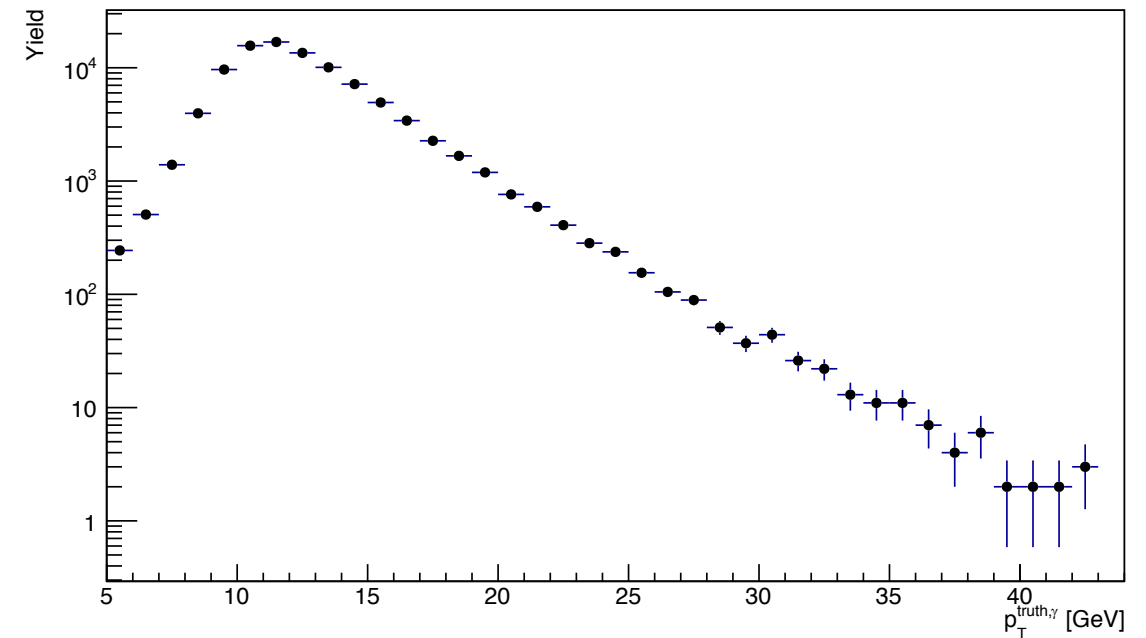
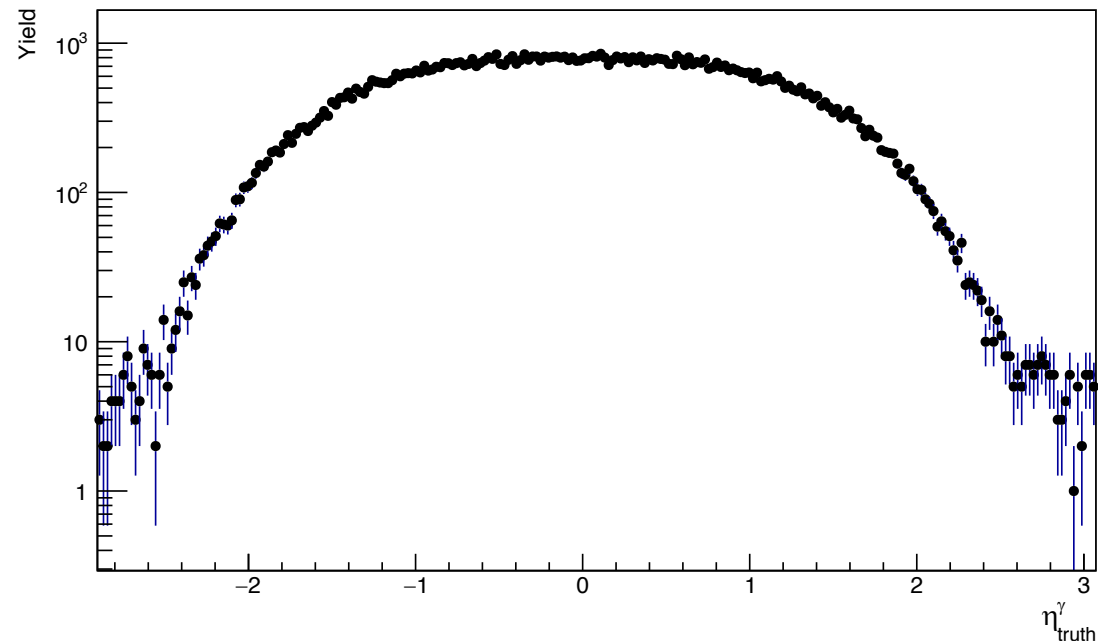
- In p+p collisions we should be able to measure to lower p_T^γ since the underlying event is smaller
- How low can we reliably measure?
- Using PYTHIA8 with all prompt photon processes
 - Require PhaseSpace:pTHatMin = 10.0
 - Require reconstruction $p_T^\gamma > 10$ GeV
 - Unless otherwise indicated jets are anti- k_T $R=0.4$

Jet p_T Response



- Jet p_T response is worse at lower p_T (obviously)
- At 9-12 GeV the response returns to the nominal mean+width of $\sim 0.8 \pm 0.1$ that was seen for the high p_T QM sample
- To measure $p_{\text{out}} = p_T^{\text{jet}} \sin \Delta\phi$ we need good p_T resolution, so with calo jets we likely can't below ~ 8 GeV

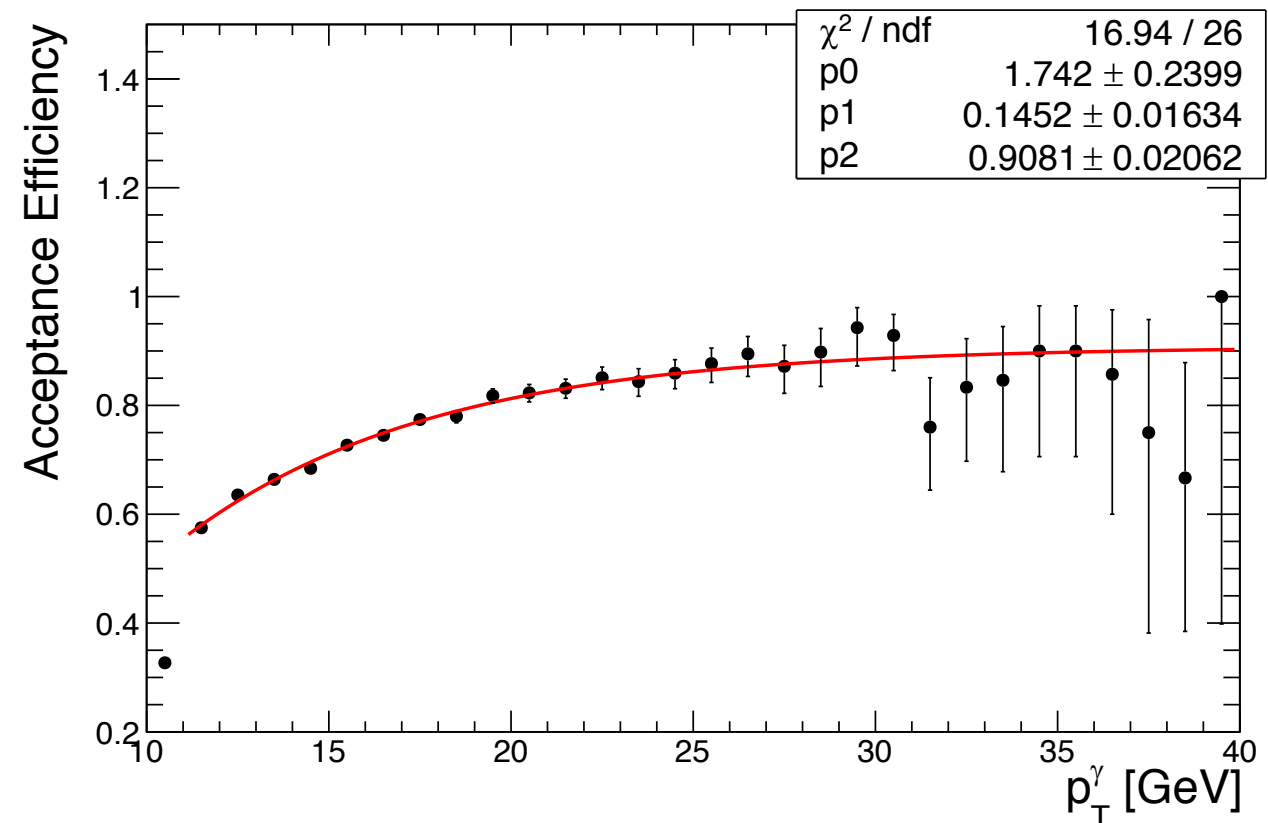
Acceptance/Efficiency



- To study acceptance/efficiency, used previously described PYTHIA sample
- Truth γ distributions shown here

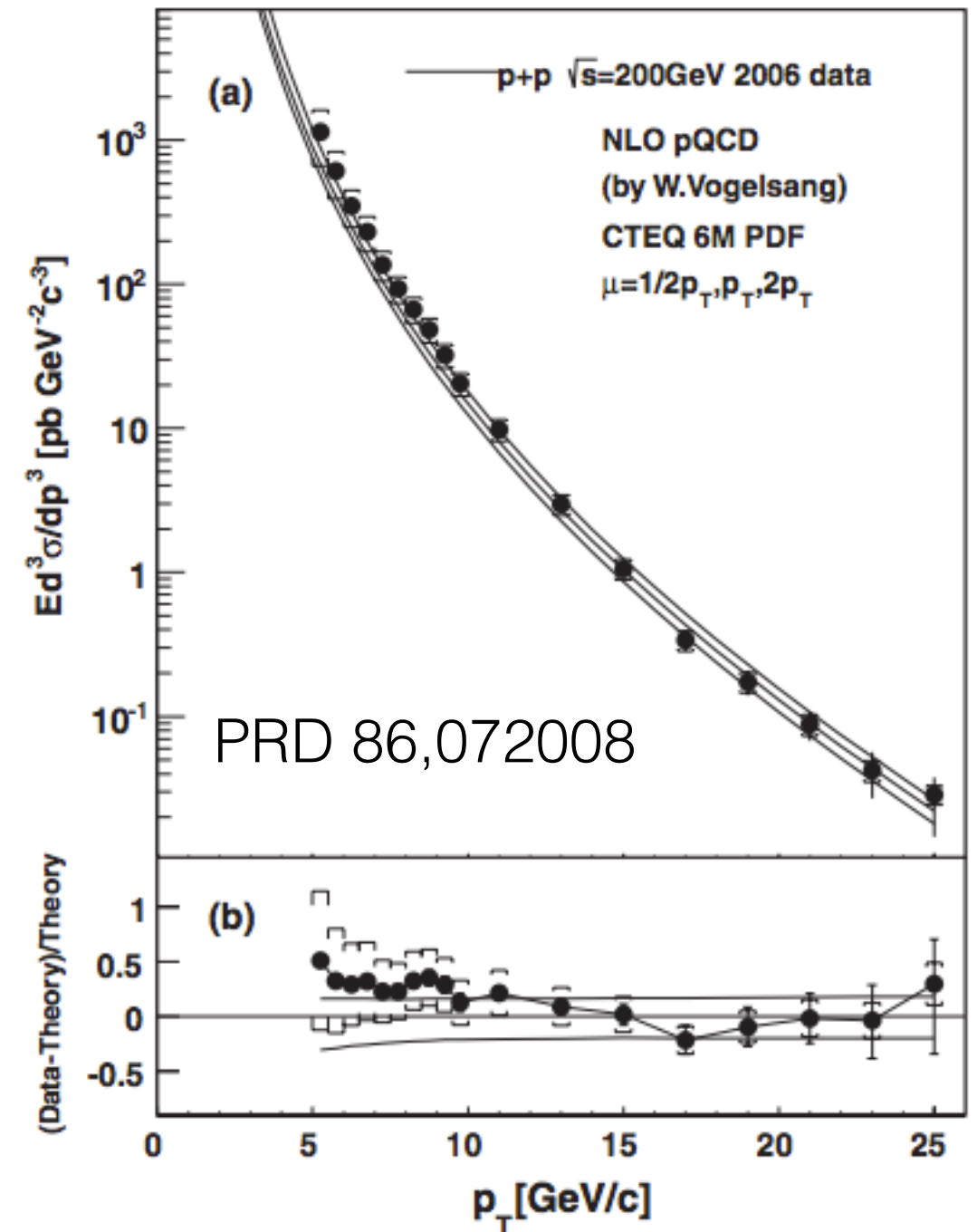
Acceptance/Efficiency

- Acceptance/efficiency determined for sPHENIX acceptance only, so really it is just an efficiency
- Fit with a saturated exponential to capture p_T dependence



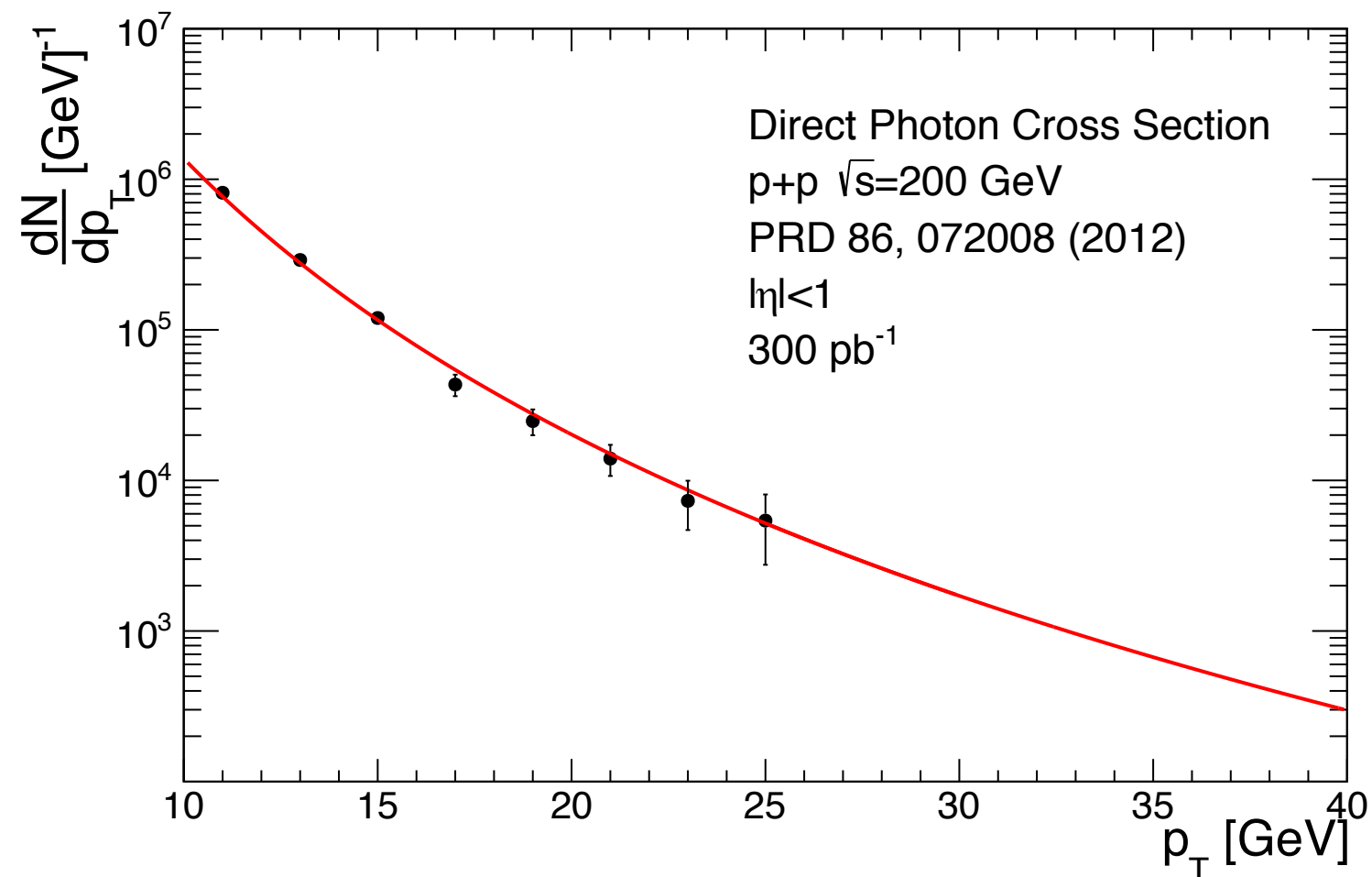
γ -Jet Yield Estimate

- No γ -jet cross section at RHIC energies
- PHENIX has a direct photon cross section
- We can translate this to yields and then apply a “ γ/γ -jet” efficiency from PYTHIA



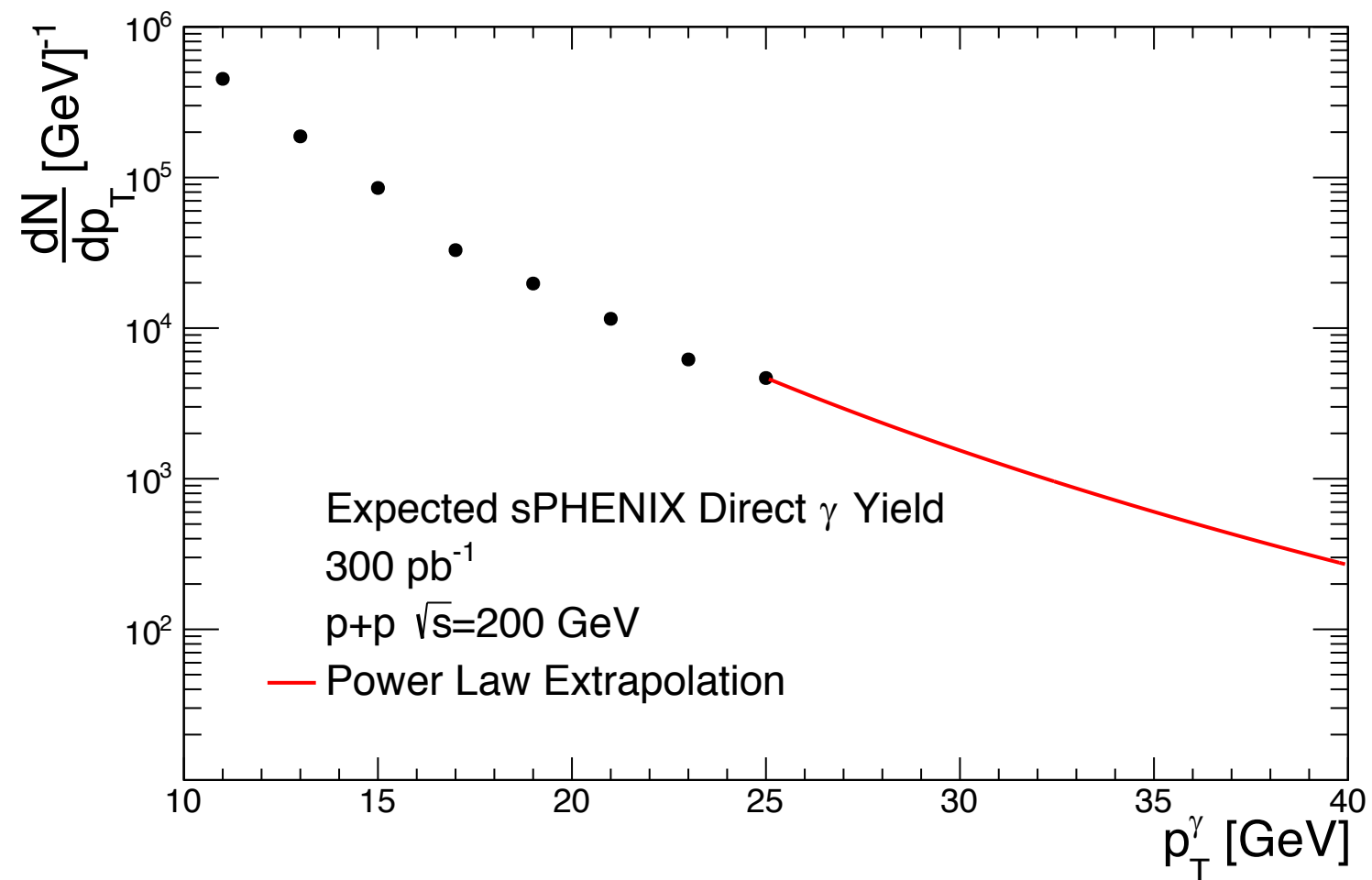
Perfect Detector γ Yields

- Cross section translated to yields
- Yields are for $|\eta| < 1$
- Fit this to a power law to get the high p_T dependence we will be able to measure at sPHENIX
- Now apply efficiencies



γ Yields

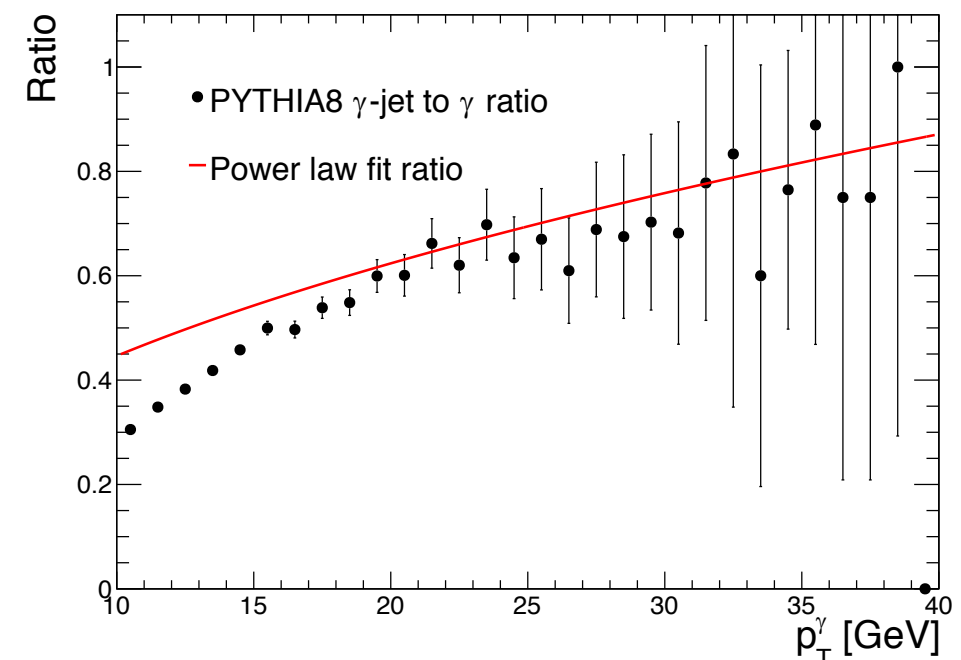
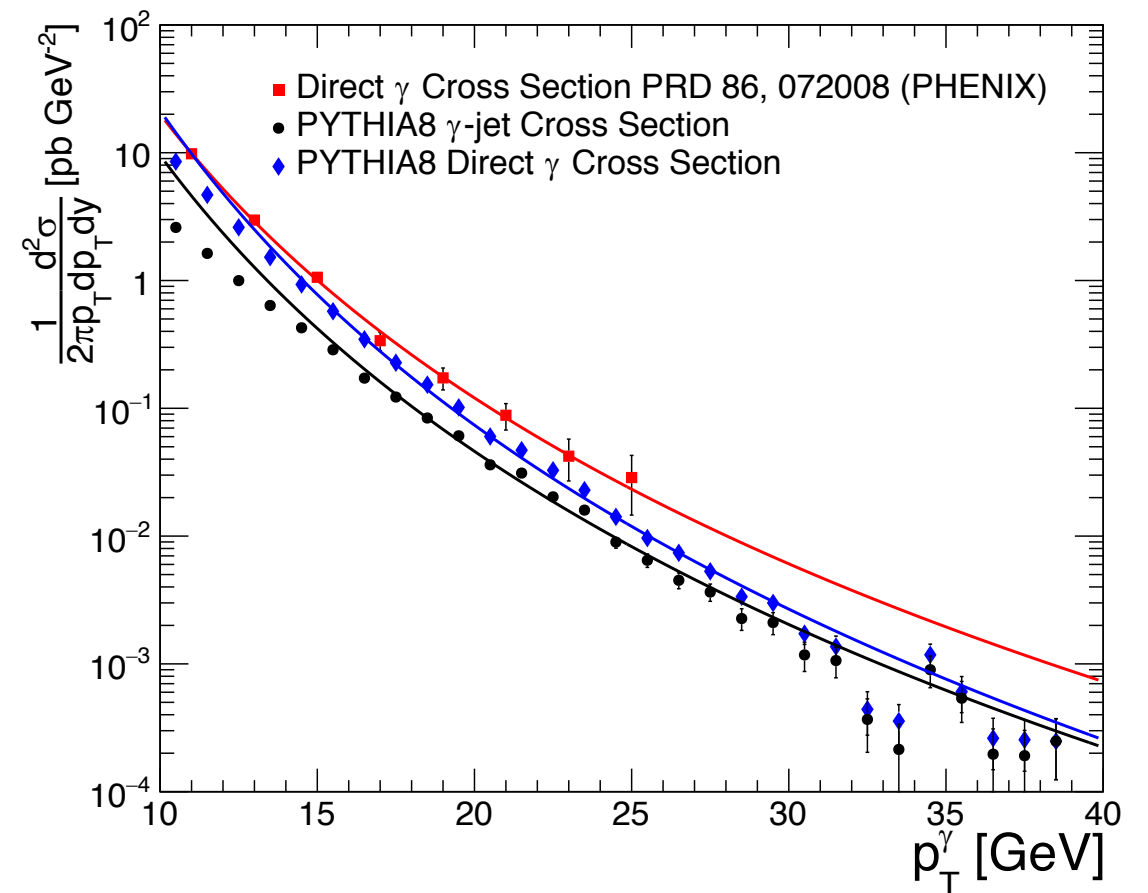
- Applied efficiency values to yields from previous page
- The power law extrapolation is just the power law fit multiplied by the saturation term from the efficiency fit



Note: 300 pb⁻¹ taken from RHIC Cold QCD Plan (arXiv:1602.03922). Jamie recently presented CAD luminosity projections to sPHENIX EC of 200 pb⁻¹; can use this to be consistent within sPHENIX for future

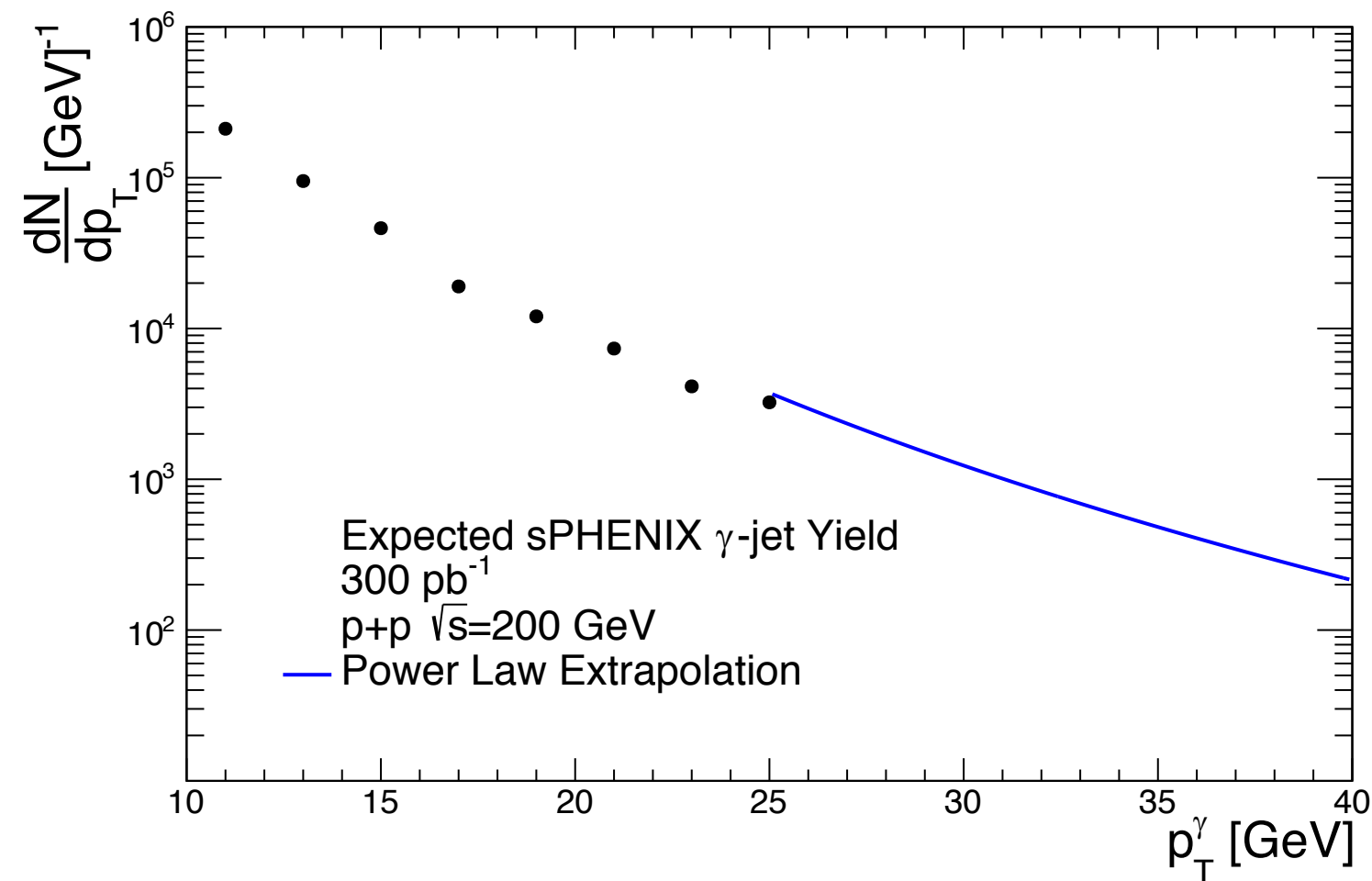
γ/γ -Jet Efficiency

- Just because you measure a direct photon does not imply you measure the associated jet
- To estimate this, plotted PYTHIA8 cross sections with PHENIX cross section
- γ/γ -jet efficiency factor defined as the PYTHIA8 γ -jet cross section to the PYTHIA8 γ cross section



Final Yield Estimate

- After applying this efficiency to the yields on page 9 we get this
- Amounts to $\sim 400\text{k}$ total γ -jet between 10-40 GeV



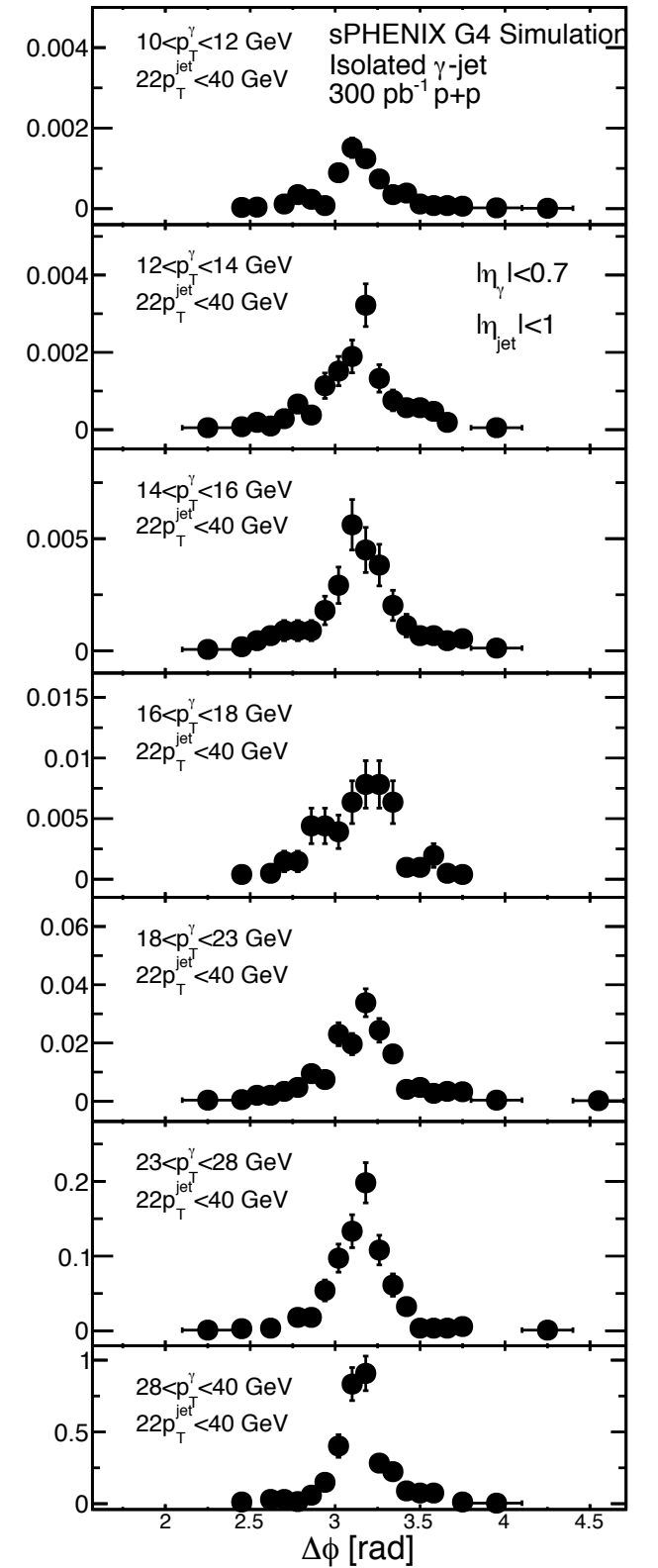
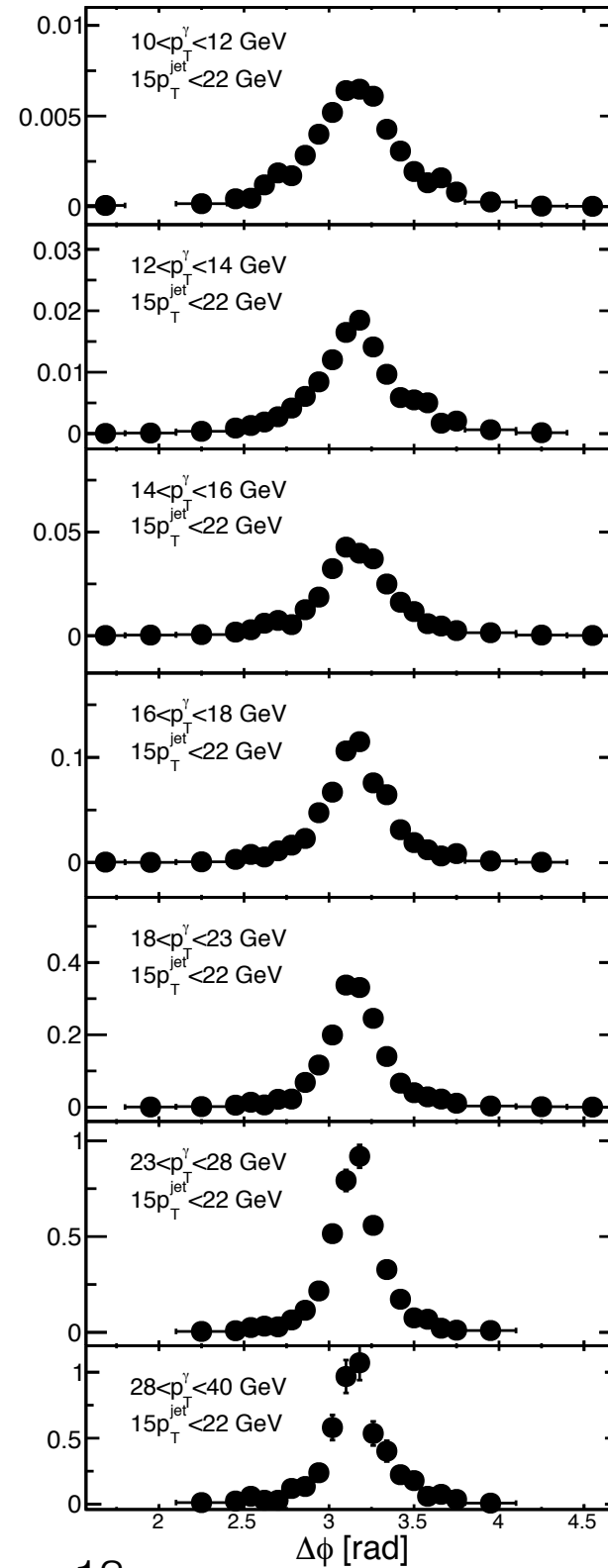
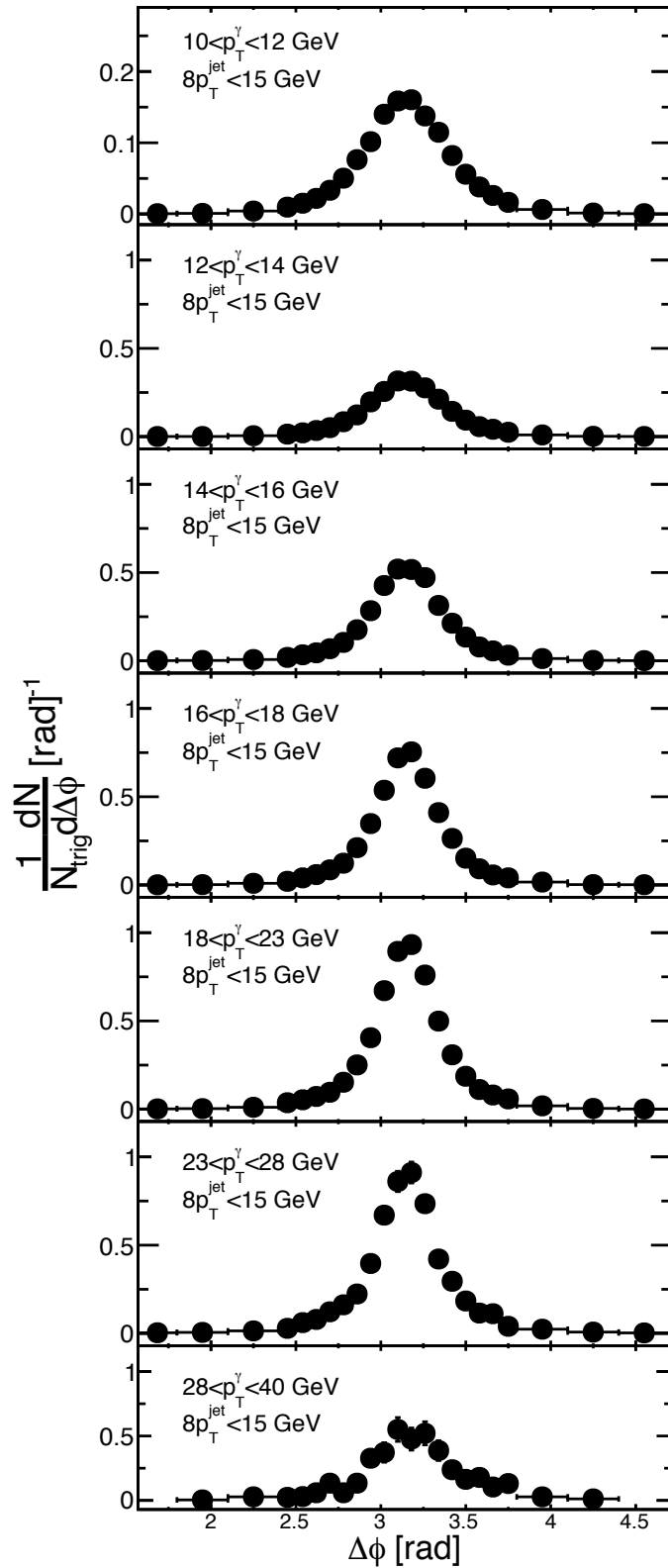
Statistical Projections

- Chris ran a large production for me corresponding to the previously estimated yields
- Imposed isolation cut of $R=0.3$ radians to try and mimic actual yields we will measure
 - Isocone criterion: $\Sigma(E_{\text{EMCal}} + p_T^{\text{tracks}}) < 0.1 \times E_{\text{iso}}^{\gamma}$
- Statistical projections of $\Delta\phi$ and $p_{\text{out}} = p_T^{\text{jet}} \sin\Delta\phi$
- Note: These are not unfolded or corrected for detector response!
- The point is just to show statistical projections of what we will measure at sPHENIX

$\Delta\phi$ Estimates

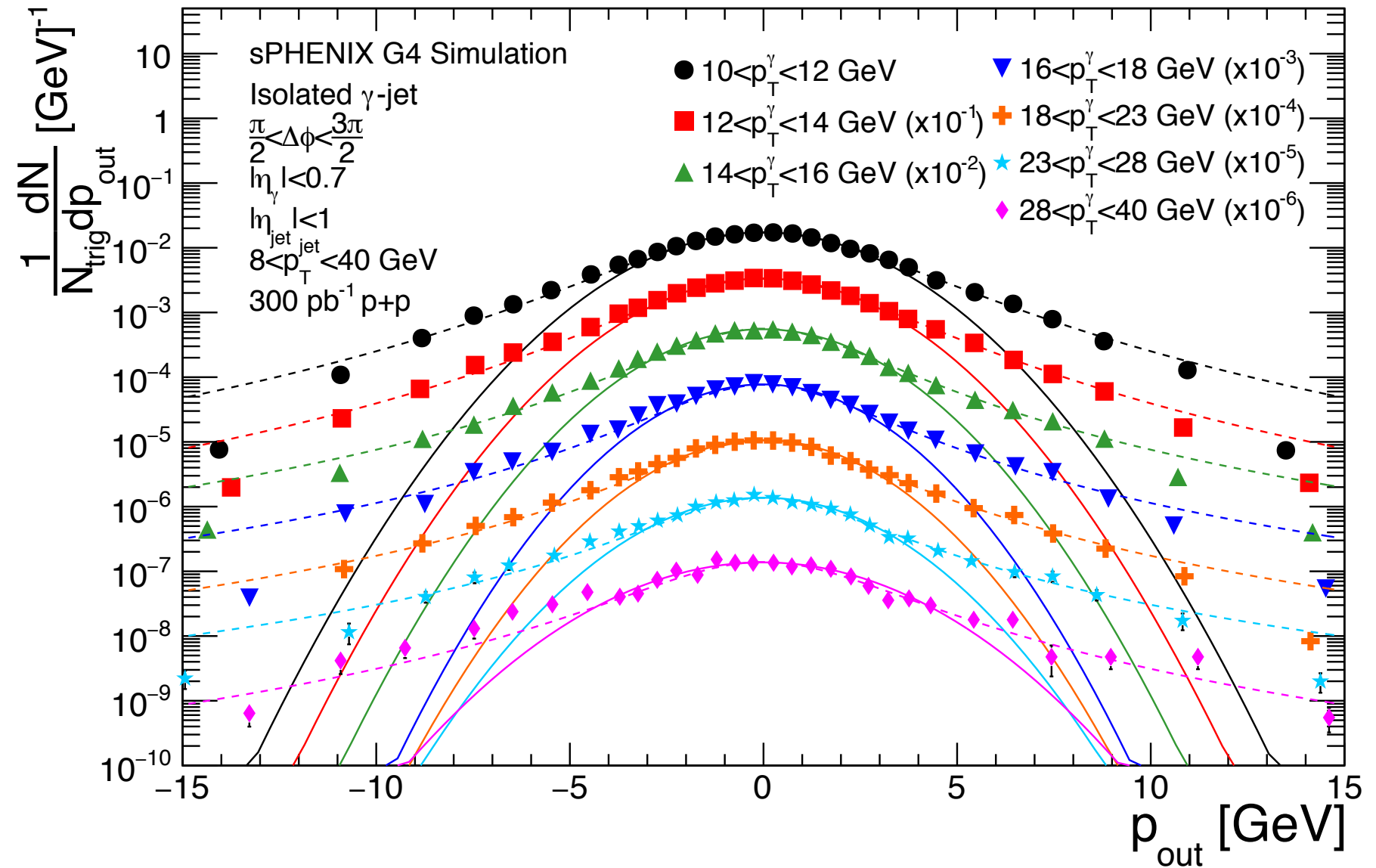
p_T^{jet} increasing \longrightarrow

p_T^γ
increasing
 \downarrow



p_{out} Estimates

p_{T}^γ
increasing



Conclusions

- Have made first look at statistical projections for some γ -jet observables in p+p collisions at sPHENIX
- Will have to re-run projections soon anyway due to the code freeze for CD1
- Nonetheless first look shows we will have lots to measure at sPHENIX
- No p+A results as this was only PYTHIA8, so that will be a future thing to look into with HIJING
- Any suggestions to improve final statistical projections are welcome; I intend to show this work at my talk at the RHIC Users Meeting